High Flow Oxygen Therapy

Reference: 1847v2
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Peer reviewers: Dr Rum Thomas
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Purpose
The following guide is aimed at the use of high flow oxygen therapy (HFOT) for the management of infants and children with acute respiratory illness, bronchiolitis or pneumonia without pre-existing co-morbidities. For the management of children with pre-existing co-morbidities please discuss with the child’s consultant.

**HFOT should not be used during the COVID 19 pandemic unless decision made by consultant after consideration of the increased risk to staff due to HFOT being an aerosol generating procedure.**

Intended Audience
All staff involved in management of patients on HFOT.
1. Introduction

**High flow nasal cannula oxygen therapy: how it works**

- High flow nasal cannula oxygen therapy (HFOT): the delivery of gases via tapered nasal cannula heated to 37 °C humidified to 100% at rates equal to or more than peak inspiratory flow rate.

- Mechanism of action: Matches inspiratory flow rate
  - Clears anatomical dead space
  - Reduces metabolic demand\(^1\)
  - Provides airway distending pressure\(^2\)

- There is limited high quality evidence for the use of HFOT\(^3\) however it has been shown to reduce heart rate and respiratory rate within 1 hour of initiation of treatment and may be as effective as CPAP at reducing the need for intubation and ventilation.\(^4,5\)

- It is simpler to administer than CPAP and is more comfortable for the patient. There have been a few reported cases of barotrauma\(^6\). It can cause mucosal trauma and bleeding.

2. Intended Audience

All staff involved in management of patients on HFOT.
3. Guideline Content

For children who have pre-existing co-morbidities, if the diagnosis is not bronchiolitis or pneumonia or they have an additional diagnosis for example laryngomalacia please discuss with the child’s responsible consultant and ensure a management plan is documented in the notes. The decision to start HFOT should be made by the medical/PCCU ST4+ doctor or equivalent assessing the patient and the responsible consultant must be informed.

**Indications for the use of HFOT**

Consider using HFOT in patients who have 2 or more of the following:

- Moderate respiratory distress (assessment of recessions, nasal flaring, head bobbing, tracheal tug)
- Apnoea in infants less than 6 months of age with bronchiolitis
- Respiratory rate scoring 2 on the PEWS chart
- Heart rate scoring 2 on PEWS chart
- S/F ratio ≤ 225 (SF ratio= SpO₂/ FiO₂; see appendix A)
- Inability to tolerate other modes of oxygen delivery in order to achieve desired saturations
- PaCO₂ ≥ 8.5kPa ( or PaCO₂ more than 2kPa above baseline)

**HFOT is not appropriate if:**

- Severe respiratory failure requiring NIV or I&V as indicated by:
  - S/F ratio ≤ 150
  - pH less than 7.2
- Cardiovascular instability
- Upper airway abnormalities that may make it ineffective or potentially dangerous (e.g. choanal atresia, cleft palate, tracheoesophageal fistula)
- Pneumothorax

**Establishing patient on HFOT**

- Select appropriate sized nasal cannula for the child. These must not occlude more than 50% of the child’s nostrils
- Stop feeds initially
- Insert nasogastric tube if required for feeding
- If nasogastric tube is not inserted observe child for gastric distension and insert if required
- Start with FiO$_2$ 0.40
- Oxygen can then be adjusted to achieve target saturations (90-93%)
- If the patient is requiring FiO$_2$ of $\geq$0.6 they will need discussion with paediatric consultant and PCCU
- Start with a flow rate of 2L/kg/min ensuring this does not exceed the maximum flow for the cannula size (see table below)
- The flow can be increased to 3L/kg/min (ensuring this does not exceed maximum flow rate), flow can be increased to maximum flow rate for nasal cannula. This can be done over a short period of time if felt necessary
- Blood gas ideally prior to starting or as soon as possible after starting
- Patients work of breathing, respiratory rate and heart rate will often improve within the first hour of starting high flow. If this happens they should be left on the flow rate that has led to this improvement

**Observations**

- Complete all observations of PEWS charts in line with guideline (984)
- Complete HFOT chart (appendix B) alongside PEWS charts
- Observations every 30 minutes for the first 2 hours. If stable at 2 hours change to hourly observations.

**Nursing Ratios**

- Assess the ward acuity through the use of the safe care system and escalate to site manager (bleep 524) as needed

**Nebulisers**

- If a patient requires a nebuliser whilst on HFOT the HFOT must be stopped for the duration of the nebuliser. If the HFOT is not stopped they will not receive the nebulised drug.
Optiflow Nasal Cannula | Delivery device | Weight range | Minimum flow rate | Maximum flow rate | Starting flow rate | Mode
--- | --- | --- | --- | --- | --- | ---
Junior Neonatal size yellow | Air oxygen blender | 2-8kg | 4L/min | 8L/min | 2L/kg | air oxygen blender
Junior Infant size purple | Airvo2 | 3-15kg | 5L/min | 20L/min | 2L/kg | paediatric
Junior Paediatric size green | Airvo2 | 12-22kg | 10L/min | 25L/min | 2L/kg | paediatric
Nasal cannula small | Airvo2 | Depended on nares size - 50% occlusion | 10L/min | 50L/min | 13-15kg use 30L | adult
Nasal cannula medium | Airvo2 | Depended on nares size - 50% occlusion | 10L/min | 60L/min | 16-30kg use 35L | adult
Nasal cannula large | Airvo2 | Depended on nares size - 50% occlusion | 10L/min | 60L/min | >50kg use 50L | adult

The cannula that will be used most commonly will be the junior infant size and the junior paediatric size. Flows >25L increase gradually over 2 minutes.

**Supportive care**

- Stop feeds initially
- Give IV fluids and restrict intake to 80% maintenance
- Monitor fluid balance
- Consider nursing infants prone (need to be on continuous monitoring)
- Nurse children with head end elevated to 30 degrees
- If child stabilises after 4-6 hours with continued HFOT introduce nasogastric feeds after discussion with medical staff
- Observe for signs of gastric distension/non-absorption of feeds

- **If patient is agitated/ unsettled:**
  - Rule out hypoxia
  - Use nursing methods to settle the infants: swaddling/ patting
  - Consider chloral hydrate 15mg/kg (max 1g qds), initially 6 hourly, in unsettled infants. Only use in infants with normal or improving blood gases. Do not use in small babies with apnoeas or those with other contraindications to chloral hydrate.
Transferring patients on HFOT

- Patients must be accompanied by a doctor who is able to apply PEEP using a bagging circuit (this will usually be a PCCU doctor/ANP) and a nurse
- Airvo2 transport units are available but should only be used by trained staff

Escalation

- Patients started on HOFT should be reviewed by an appropriately trained clinician within 1 hour after starting or sooner if required
- Assess: work of breathing, respiratory rate, heart rate and saturations
- If the patient is deteriorating or showing no signs of improvement escalate as per PEWS guideline (984)
- Flow can be increased to maximum for nasal cannula as per table above
- FiO₂ should be increased to maintain SpO₂ ≥ 90%
- Review ABC
- Check equipment, circuit and nasal cannula for position and obstruction
- Consider pneumothorax (examination and CXR), aspiration, gastric distension
- Discuss with consultant and consider transfer to PCCU for increased respiratory support
- While waiting for help increase FiO₂ to 1.0 if required and call 2222 if needed
- If the patient when reviewed at 1 hour has not deteriorated but has not improved the reviewing doctor will need to decide if the patient requires escalation to PCCU or can remain on HFOT on the ward for a longer period of observation. The plan should be recorded in the notes.

Weaning

- SpO₂ > 93% or greater than prescribed target wean FiO₂ as you would for low flow oxygen
- Once a period of stability is achieved and FiO₂ is <0.3 and their work of breathing has improved the high flow can be stopped
- Patients should be reviewed by a doctor before HFOT is stopped
4. References


Acknowledgments:
Thank you to the authors of the Leeds Children’s Hospital guideline for allowing their guideline to be used as reference in producing this guideline. (Dr C Edwards, Dr J Lumsden, Dr C Smith, Dr Evie Robson, Mrs S Coulson, Mrs A McDermott)
Appendix A

Assessment of hypoxia

- We routinely use oxygen saturation and the amount of oxygen the child is receiving to assess their degree of hypoxia but it is often difficult to know how much oxygen the child is actually requiring to maintain their oxygen saturations at an acceptable level.

- Monitoring of hypoxia is based on partial pressure of arterial oxygen to fraction of inspired oxygen (PF ratio = \(\frac{\text{PaO}_2}{\text{FiO}_2}\)); it has been found that there is good correlation between this ratio and oxygen saturations to fraction of inspired oxygen (SF ratio = \(\frac{\text{SpO}_2}{\text{FiO}_2}\)).

- Oxygen saturations to fraction of inspired oxygen the SF ratio (\(\frac{\text{SpO}_2}{\text{FiO}_2}\)) is a tool that can be used alongside the usual observations to assess the degree of hypoxia so that any deterioration can be identified and treated accordingly.

- The SF ratio is calculated using the following calculation: 
  
  \[
  \text{SF ratio} = \frac{\text{SpO}_2}{\text{FiO}_2}
  \]

  E.g.: A child with saturations of 95% in \(\text{FiO}_2 0.35\) (35% oxygen) 
  
  SF ratio is \(95/0.35 = 271\)

  SF ratio of <320 indicates the child has hypoxaemia and requires close observation for deterioration. Monitor using standard PEWS charts with reassessment of the SF ratio if there is any deterioration.

- In order to calculate SF ratio you need to know the fraction of inspired oxygen (\(\text{FiO}_2\)) being administered. This is difficult to assess accurately with nasal cannula and face masks. It can be determined with a well fitted Venturi mask. When a patient is receiving High Flow Oxygen Therapy (HFOT) you will know the \(\text{FiO}_2\).

- When looking at oxygen saturations it is important to wean down the oxygen you are giving until their oxygen saturations are < 97%. This is because the oxyhaemoglobin dissociation curve remains constant >97%.
### Appendix B

**Nursing observations for patients receiving HFOT**

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Affix patient label or complete

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Appendix C
HFOT in the SCH ED

Diagnosis Bronchiolitis - Requiring admission

Paediatric medical senior decision: needs HFOT/NIV/ invasive ventilatory support

Needs HFOT

Needs NIV/invasive ventilatory support – PCCU for immediate review, management and transfer to PCCU

Is the need for HFOT time critical – (needs to start within one hour)

No

Commence on standard nasal cannula O₂.
ED Nurse coordinator informs bed manager – requires admission to ward for HFOT within 1 hr

If there is a delay in finding a bed - delivery of HFOT in ED* should be considered.
D/w #524, ED nurse in charge, senior ED and medical team.

#524 to arrange appropriately trained staff to nurse patient in ED.

Senior clinician to decide if the patient will tolerate temporary suspension of HFOT during transfer to ward. **

Yes

Transfer to ward on face mask oxygen.

No

524 to decide who is most appropriate to transfer: use high flow oxygen transport unit/ facemask with Ayer’s T-piece to provide continuous PEEP.

Yes

Inform ED nurse coordinator and Senior ED/medical team.
Paediatric team call PCCU team, PCCU doctor/ANP to attend and review urgently.
If agreed to be most appropriate treatment - commence HFOT in ED*.
Inform 524 bleep holder who will book a bed on both the ward and PCCU. ***

Review by PCCU doctor/ ANP in ED at 30-60 minutes: decide appropriate location of patient - PCCU or ward.

Patient improved?

Yes

Transfer to PCCU by PCCU team.

No

** If the ED Nurse disagrees with the decision to discuss with the ED Nurse co-ordinator and 524

*** When patient location has been decided after 30-60 minutes of treatment the alternative location should be cancelled.

*ED nursing staff currently not trained in the use of HFO – PCCU or ward staff required to set up HFO and remain with patient until ED nursing staff have the appropriate training.